Saskatchewan
Ministry of
Environment

Assessment of Nemeiben Lake Fish Stocks, 2003

Fish and Wildlife Technical Report 2008-2

By Mark Duffy
August 2008

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Ministry of Environment
Fish and Wildlife Branch
La Ronge, Saskatchewan
Canada

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Introduction

Nemeiben Lake is a mid-sized (15,483 hectares) lake situated 20 km north of the town of La Ronge in north-central Saskatchewan. The fishery of Nemeiben Lake supports many different users including recreational anglers, commercial fishing, and subsistence netting. Recreational anglers access the lake through either the outfitting lodge, the provincial campground, or private cabins situated around the lake. The community of Sucker River is located at the downstream end of Nemeiben Creek, where it flows into Lac la Ronge (Figure 1).

The lake has been studied previously in 1960-61, and 1991-92 to determine the state of the fish resource and results of various management options that have occurred over the years. Wallace (1993) provides background on the development of various dispositions on the lake. At present there are 70 recreational leases and one outfitting camp, which has subdivided its property into recreational cottage lots. While the outfitting licence still exists, there is presently no allocation associated with it for Nemeiben Lake until fish stocks have recovered to a point that the department feels the lake can withstand the additional pressure.

Based on reports of poor angling success for walleye from sport anglers, as well as decreasing walleye harvests in the commercial catch, a test net survey was undertaken in 2003. The purpose of this study was twofold, firstly to determine the health of the fish stocks in Nemeiben Lake, and secondly to provide a baseline on which to gauge the success of management actions taken that year. Potential harvests on the lake were reduced in the spring of 2003 prior to the test netting survey by designating the lake as Catch and Release 1 (CR1), as well as a reduction in the commercial fishing quota. Should future studies show that walleye stocks in Nemeiben Lake are still in decline, further management actions may be needed.

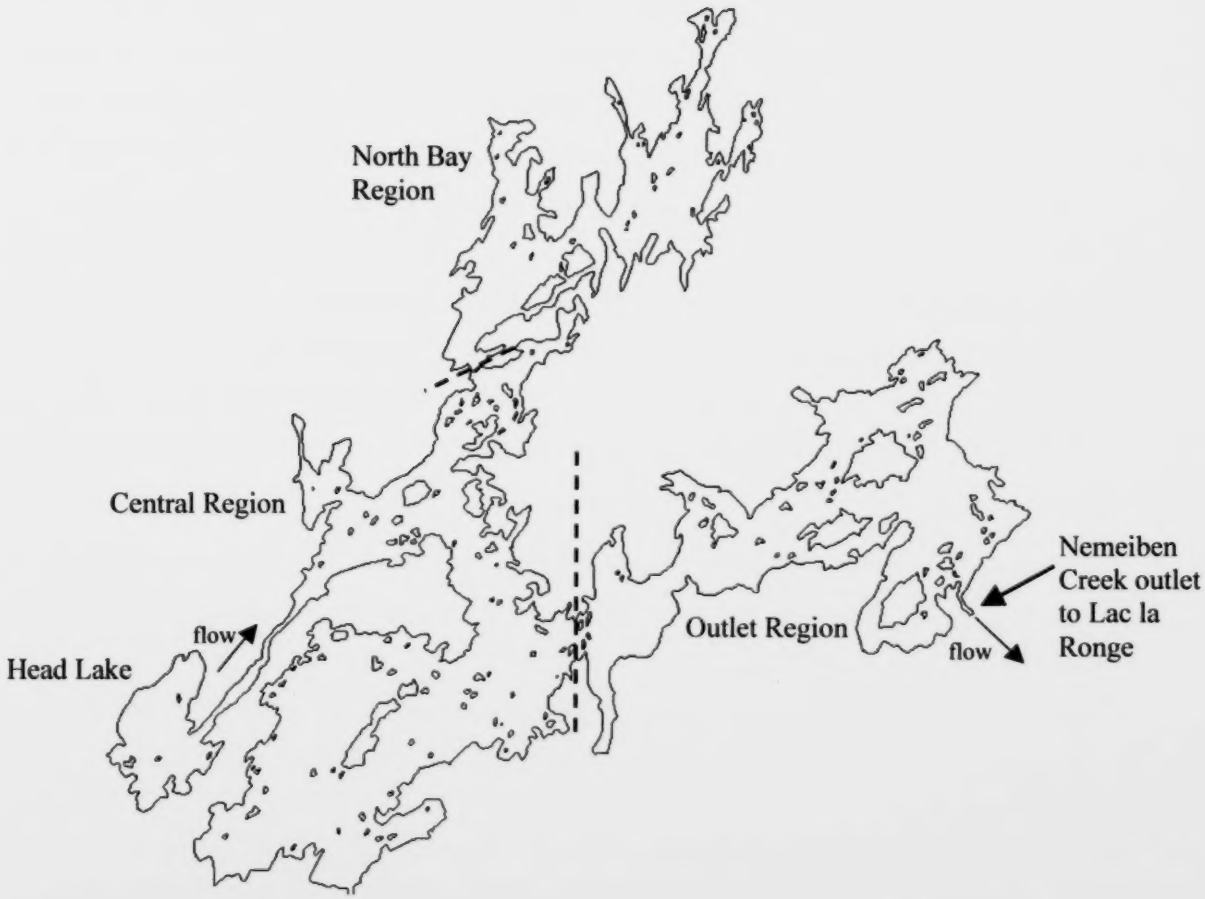

Figure 1. Nemeiben Lake showing the three distinct basins as well as inlet from Head Lake and outlet to Lac la Ronge

Methods

Standard gang test nets (stretched mesh sizes 1.5", 2", 3", 4", 5", and 5.5", 46m each) were set in locations used in previous studies to provide information on fish stocks in Nemeiben Lake (Appendix 1). During the 1991/92 study a total of 13 net sets were used in the three distinct regions of the lake, although the data from one net set (#2) was discarded as it was tampered with. In order to more accurately sample the three regions in proportion to their surface area of the lake, an additional 4 net sets were done in the central region during the current study, for a total of 17 lake-wide (Table 1). Netting occurred during June, July and August of 2003.

Fish harvest estimates from all user groups were not gathered during the study due to various constraints, however commercial fishing and historical outfitter records are available.

Results

In order to allow for comparison to the 1991/92 study, the same net set locations were used, with an additional four net sets in the central region based on under-representation of that region in the previous study (Table 1). For comparison of abundance, data from the first thirteen nets is used, while data from all 17 nets is used in the biological comparisons. The same thirteen net sets were done in the 1960/61 lake study by Koshinsky (1964), where a total of 23 net sets were used. Data for 1960/61 were taken from Wallace (1993).

Table 1. Depths of the three regions of Nemeiben Lake and the sites of survey nets in 1960-61, 1991-92 and 2003.

Depth	Areas (%) [a]			Nets (no.) [a]		
	Outlet	Central	North Bay	1960-61	1991-92	2003
0-5 m	77	40	25	5	3	5
5-10 m	16	54	20	10	5	7
10-15 m	0	4	22	3	1	2
15-20 m	0	2	14	1	1	0
20-30 m	0	+	14	3	1	2
30 + m	0	0	5	1	1	1
% of lake	31	49	20	..	..	..
Number of nets:						
1960-61	6	10	7	23	..	..
1991-92	5	3	4	..	12	..
2003	5	8	4	..	..	17

Water area = 154.9 km^2 (59.8 $mile^2$)
Maximum depth = 39.3 m (129 feet)
Mean depth = 6.7 m (22 feet)

[a] Information on depth zones and net locations for 1960-61 and 1991-92 from Wallace (1993)

Abundance

For the purposes of comparing abundance between survey years, only the first 13 net sets from 2003 are used. An average of 137.8 fish per survey net was seen in 2003, with a range from 48 to 230 fish per net (Table 2; Appendix 2). This is a slight increase from the 134.9 fish per net seen in the 1991/92 survey. The mean number of fish per survey net increased by 10.6% from the previous study, and 65.7% from the original study in 1960/61.

The mean number of sport and commercial fish (walleye, pike, trout, and whitefish) per net decreased slightly from 51.8 in 1991/92 to 49.1 in 2003, while the overall catch increased from 622 fish to 638. This was due to the increased catch of lake trout and whitefish as both northern pike and walleye catches decreased compared to the previous study. Non-sport and non-commercial species (cisco, white sucker, long nose sucker, perch and burbot) increased in abundance from 83.1 per net in 1991/92 to 88.7 in 2003, with the overall catch increasing from 997 to 1153 fish. Table 2 illustrates trends in number of fish per survey net based on the three surveys done on Nemeiben Lake. Sport and commercial fish species have been analyzed separately based on their preferred habitat. Overall, relative abundance of sport and commercial fish has decreased from 38.4% to 35.6%: walleye from 8% to 3%, pike from 14% to 10%, while trout increased from 2% to 3% and whitefish from 14% to 20% (Figure 2).

Wallace (1993) performed a weighted average and confidence limits on the 1991/92 fish catches from Nemeiben Lake to account for biases due to net locations not accurately reflecting the relative area of different habitats in a lake. The data from the 2003 survey was analyzed in a similar manner (Appendix 3). As expected, the weighted average for most species reflected the trends seen in the simple average. There were still declines in walleye and northern pike, however the weighted average for cisco in 2003 increased compared to 1991/92 whereas the simple average showed a decrease. This was due to the large number of cisco caught in shallow (0-15m) nets in 2003 compared to the catches in the previous study. The declines in walleye and pike also caused a slight decrease in the weighted average of sport and commercial species between studies, while the simple average showed a slight increase.

Table 2. Comparison of numbers of fish per survey net, 1960/61, 1991/92 and 2003.

Species	Year	Number		
		Mean	Minimum	Maximum
All Species	1960-61	90	11	183
	1991-92	135	47	406
	2003	136	48	234
Non-sport non-commercial	1960-61	48	9	136
	1991-92	83	12	348
	2003	90	18	186
Walleye (depths < 15m)	1960-61	27	0	70
	1991-92	15	6	47
	2003	5	0	24
Pike (depths < 15 m)	1960-61	12	0	28
	1991-92	25	0	63
	2003	18	3	42
Trout (depths > 15m)	1960-61	0.6	0	1
	1991-92	7.3	6	10
	2003	10.6	7	15
Whitefish (depths > 15m)	1960-61	27	3	89
	1991-92	50	45	57
	2003	50	14	87

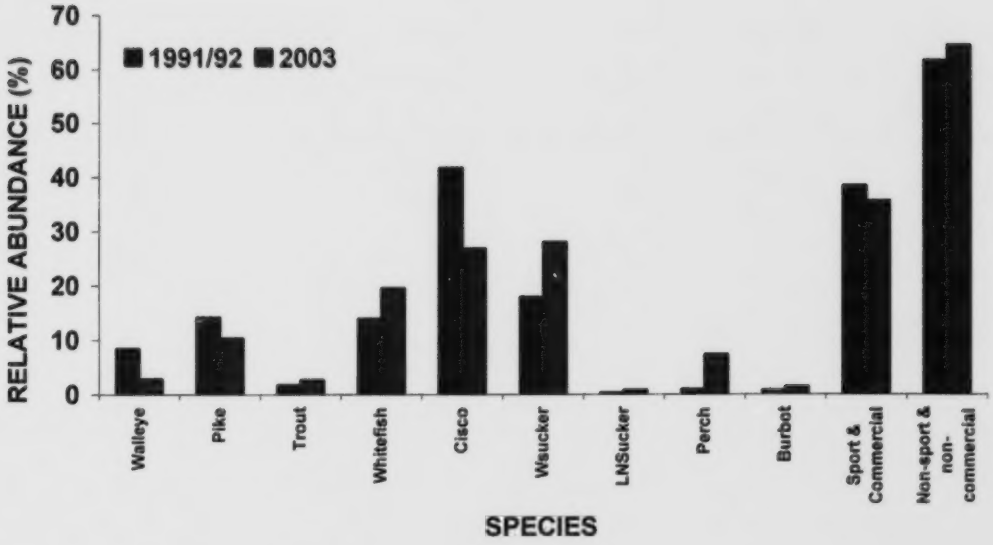

Figure 2. Relative abundance by species of fish caught in 13 test nets, Nemeiben Lake 1991/92 and 2003. Sport and commercial species include walleye, pike, lake trout and whitefish.

Walleye

Similar to the results from the previous studies on Nemeiben Lake, the abundance of walleye in the 2003 survey nets has decreased (Table 2; Appendix 2). Lake-wide, walleye numbers decreased to 37.2% of the 1991/92 results, and only 19.5% of the 1960/61 results using the 13 net sets used in all three surveys. Walleye represented 39, 30, and 10% of the total catch in the outlet, central, and north bay regions in the 1960/61 survey, respectively. A similar analysis was not done in 1991/92 due to inequity in the proportion of net sets by region. In the 2003 survey the proportions were corrected, resulting in 2.2, 0.3, and 0% of the total catch by region, respectively.

Walleye caught in the 2003 survey exhibited a weak bi-modal fork length distribution (Figure 3), with large peaks at 43-44 and 47-48cm, and a small peak from 31-34cm. There is an absence of walleye smaller than 27cm fork length, as well as from 35-39 cm. Data from 19660/61 and 1991/92 show a more normally distributed size structure. Mean fork length at capture increased from 38.3cm in 1991/92 to 44.6 in 2003.

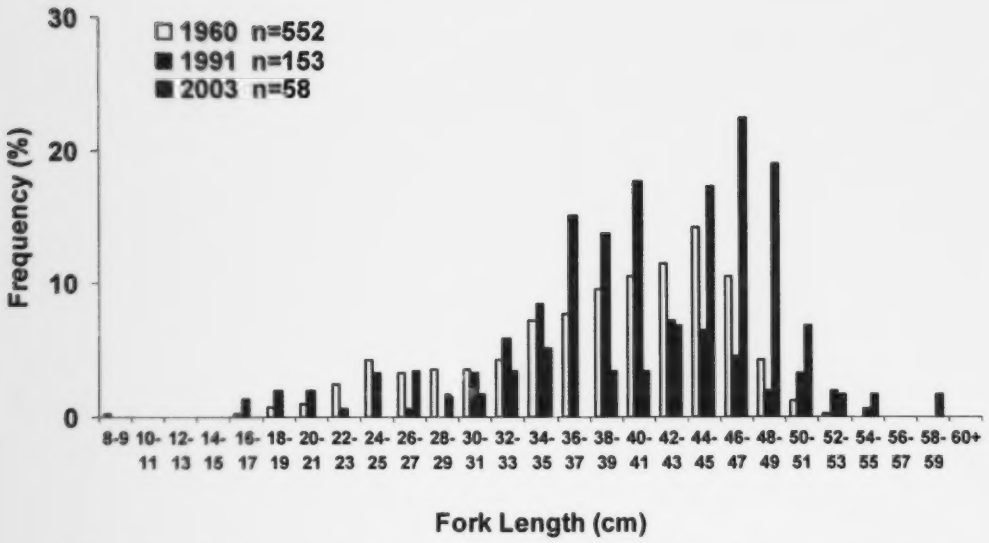

Figure 3. Fork length frequency for walleye from test nets, Nemeiben Lake 1960/61, 1991/92 and 2003.

Age frequency for the 2003 survey shows peaks at ages 3 and 6, with a total of 15 year classes represented (Figure 4). Age 4 and 5 fish are under-represented, and the curve does not display the usual undulation of a stable and healthy walleye population. A noticeable lack of age 1 and 2 fish is seen, which is most likely due to an aspect of walleye behaviour or netting selectivity. Ageing data from 1991/92 was corrected to a 1991 age for analysis (that is 1992 age-1). A total of 12 year classes were present with a noticeable change in distribution after age 4. The large presence of age 1 and 2 fish may be due to strong year classes entering the system.

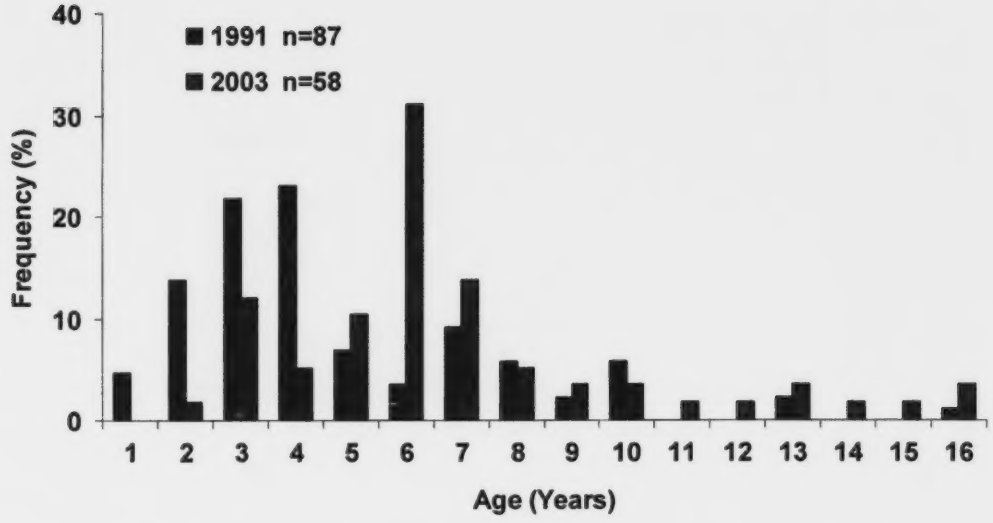

Figure 4. Age frequency for walleye from test netting, Nemeiben Lake 1991-92 and 2003.

Growth for walleyes from the 2003 study was considerably faster than seen in the 1960/61 study (Figure 5), although similar to rates seen in 1991/92. Increased length at age is a characteristic of an exploited percid population (Spangler et al., 1977). Walleye growth appears to level off after age 8 in the current study, although this is most likely the result of a small sample size rather than an indication of actual walleye growth in Nemeiben Lake. The similar growth rates between 1991/92 and 2003, in spite of other indicators of increased exploitation may be indicative of a maximal growth rate for walleyes in Nemeiben Lake.

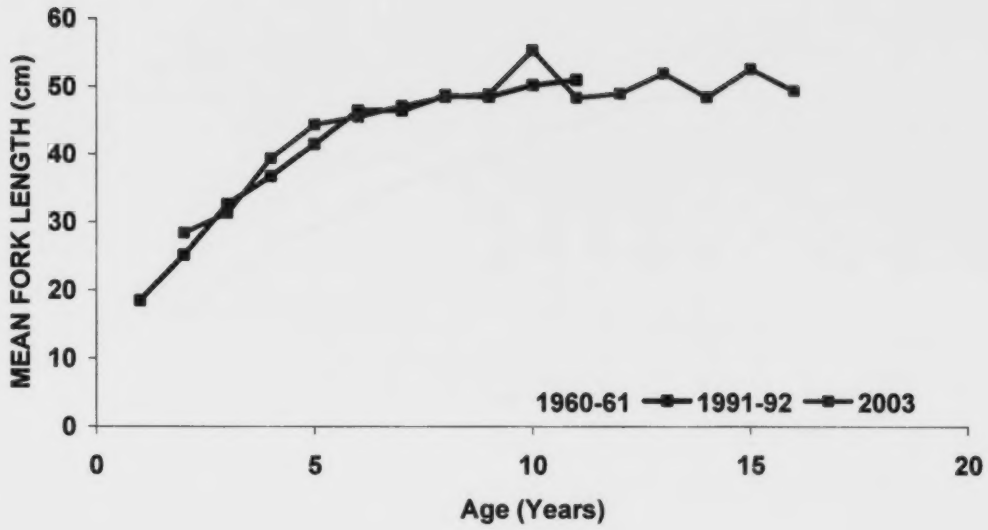

Figure 5. Length at age relationship for walleye from 1960-61 1991-92, and 2003 test netting surveys, Nemeiben Lake.

Walleye relative weight (W_r) was calculated at 92 in 2003 (Figure 6), which is slightly lower than the literature range of 95-105 which is considered a benchmark for comparisons of populations (Murphy et al, 1990). W_r from 1991/92 was also 92. Analysis of W_r by length for walleye from 2003 revealed no statistical differences. In 1991/92, walleye up to 45.0 cm total length had a significantly lower W_r than walleye 45.0cm and larger (Wr= 90 and 96, respectively) ($t=2.39$, $\alpha=0.05$). The lower W_r value corresponds to the most abundant length categories of walleye from the 1991/92 survey (Figure 3). Competition for prey may be responsible for this, with a release from the bottleneck occurring in larger fish as larger prey become available and the more abundant sizes of walleye are harvested through the various fisheries on Nemeiben Lake. A detailed assessment of forage fish and walleye diet would be needed to confirm this.

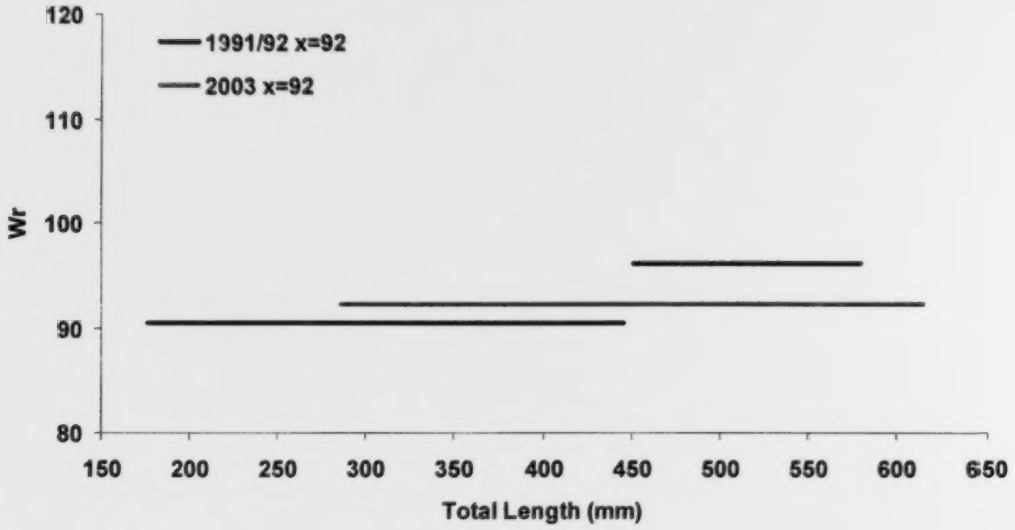

Figure 6. Relative weight (W_r) for walleye from Nemeiben Lake, 1991/92 and 2003.

Northern Pike

Northern pike populations on Nemeiben Lake also showed decreases from the previous study (Table 2; Appendix 2). Unlike walleye however, pike populations do not show a continual decline from the original study in 1960/61. Pike abundance was 80.9% of that in 1991/92 and 147.6% of that in 1960/61.

Northern pike fork length frequency for 2003 exhibited a uni-modal curve, with a peak at 55-60 cm (Figure 7). Fork lengths ranged from 19.5cm to 90.8cm with an average length of 59.1cm. Similar results were seen in 1991/92 and 1960/61.

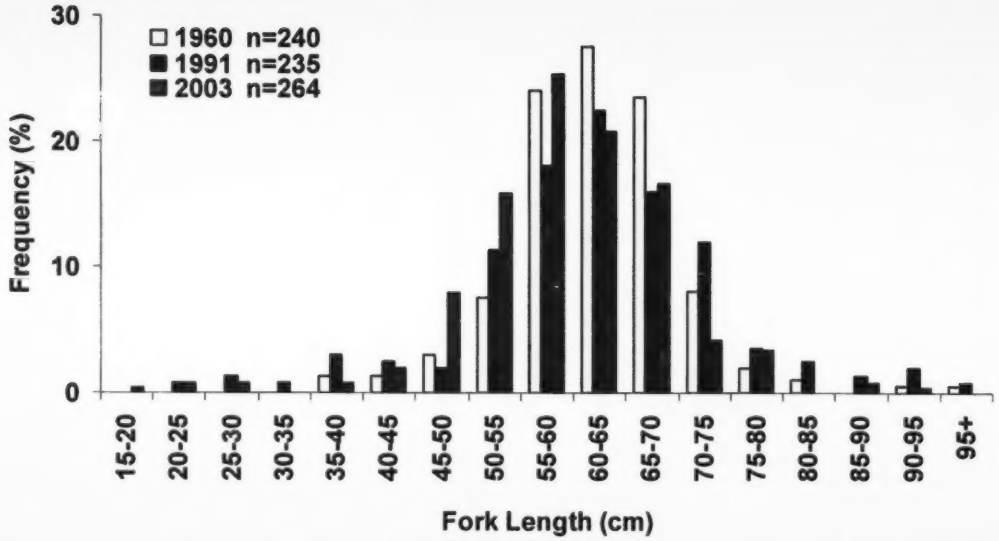

Figure 7. Fork length frequency of northern pike, 1960/61, 1991/92 and 2003, Nemeiben Lake.

Age structure of the Nemeiben Lake pike population indicates a bi-modal distribution with peaks at age 3 and 6 (Figure 8). This corresponds to the 1997 and 2000 year classes. Mean age of the population is 5.0 years. Wallace (1993) reported age 8 and 9 fish in the 1960/61 survey comprised 60% of the total catch. The current survey shows a shift to younger fish with a more even age distribution. Strong 2000 year-class abundance was also seen in Jan Lake during the 2002 study (Duffy, unpublished data).

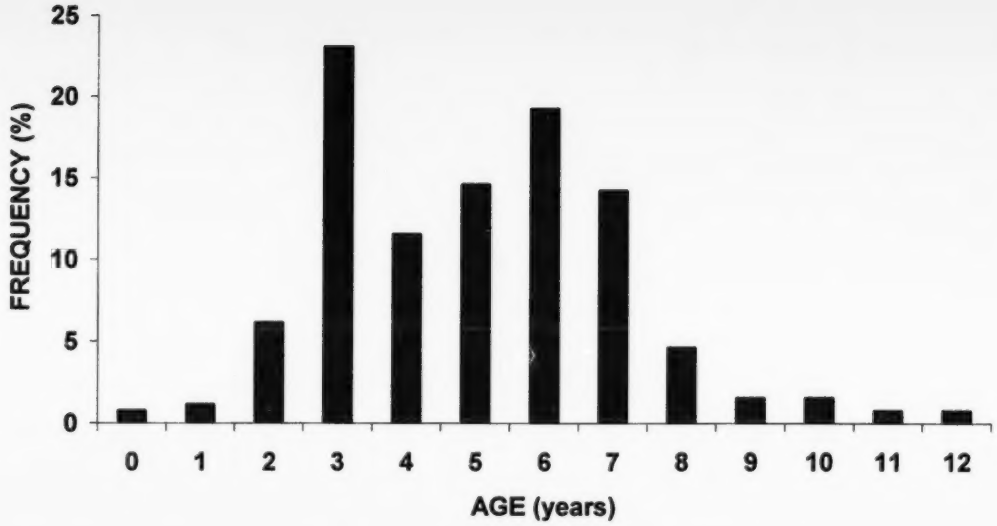

Figure 8. Age frequency for northern pike, Nemeiben Lake 2003.

Length at age for northern pike on Nemeiben Lake has increased since the 1960/61 survey (Figure 9), another indication of increased exploitation since the original survey. Pike growth appears to increase considerably after age 1, however a small sample size of age 0 and 1 (n=2 and 3 respectively) is most likely responsible for this. Growth of northern pike seen during the current survey is comparable to that seen in other exploited populations, such as Jan Lake (Duffy, in print; Gloutney 1990). During the original survey, growth of pike on Nemeiben Lake was similar to that seen in the unexploited population on Upper Foster Lake (Dean, 1979).

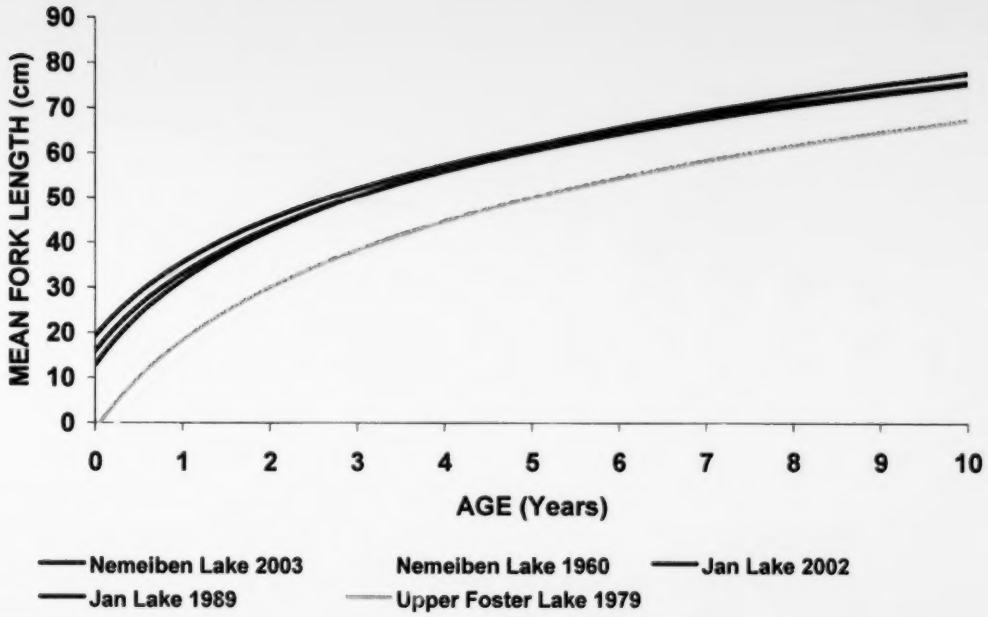

Figure 9. Length at age comparison for northern pike from Nemeiben Lake 1960-61, 2003 and other Shield Lakes.

Relative weight has changed little for northern pike in Nemeiben Lake since 1991/92, decreasing slightly from 93 to 88 (Figure 10). W_r for northern pike larger than 65.0 cm total length (84) was significantly lower in 2003 compared to smaller pike (90) ($t=4.09$, $\alpha=0.05$). Studies have shown that pike will often consume prey that are smaller than the upper size limit and those predicted by optimal foraging models (Nilsson and Brönmark, 1999). This may result in a lower W_r in larger pike if prey resources are limiting.

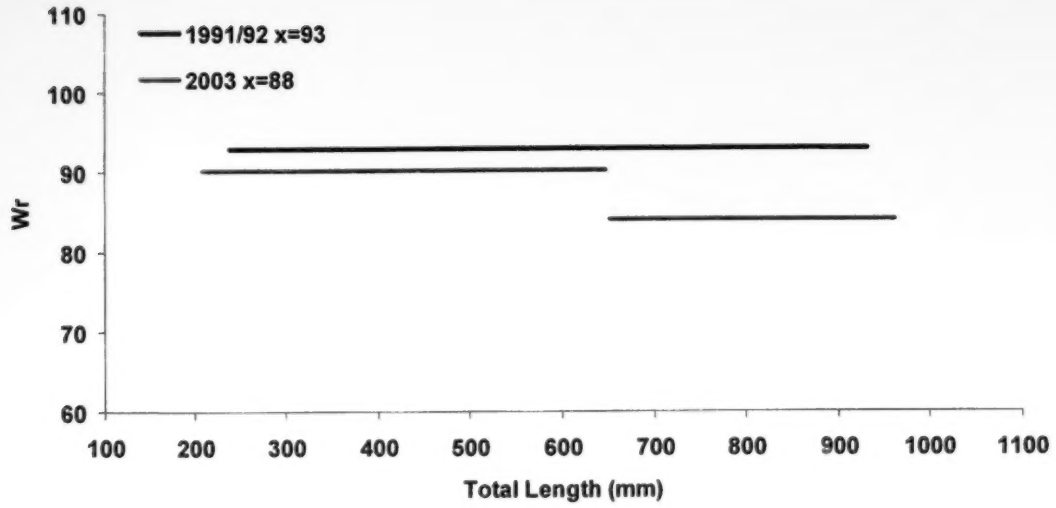

Figure 10. Relative weight for northern pike from Nemeiben Lake, 1991/92 and 2003.

Lake Trout

Lake trout catch in the 2003 survey was higher than that seen in the 1991/92 and 1960/61 surveys (Table 2; Appendix 2). A total of 48 lake trout were caught, an increase from the 29 caught in 1991/92 and the three caught in the original survey. This represents an increase of 165% and 2400%, respectively. This increase declines slightly when only using nets deeper than 15 metres as one-third of the lake trout caught in the current survey were in waters shallower than their preferred habitat. It should be noted that both of these net sets were in May when the lake has yet to thermally stratify, which increases the available habitat for lake trout.

Fork length frequency for lake trout from Nemeiben Lake shows a wide range of size classes being represented (Figure 11). Lengths ranged from 18.1 cm to 71.0 cm with a mean of 52.6 cm. While the catch was dominated by the 50-70 cm size classes, the presence of many smaller size classes indicates good recruitment to come into the fishery in future years.

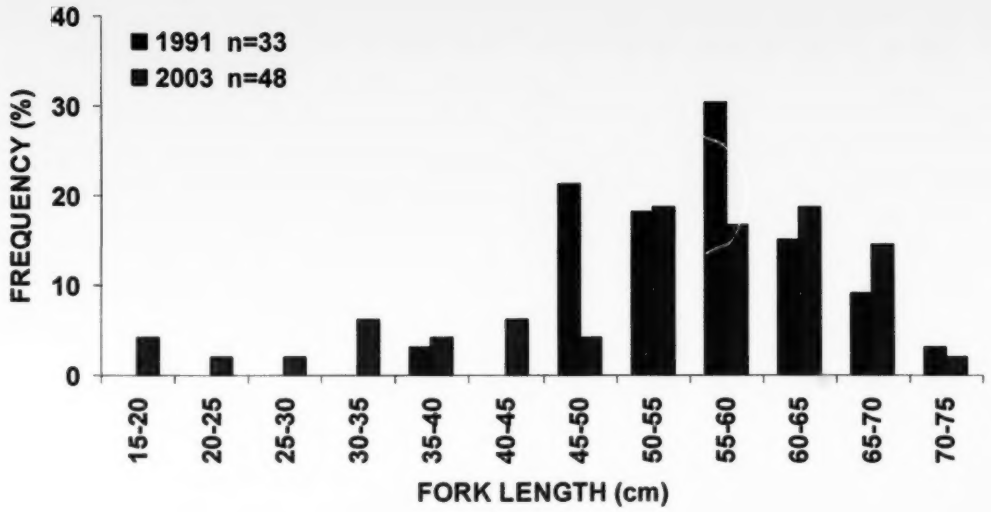

Figure 11. Fork length frequency for lake trout from Nemeiben Lake, 1991 and 2003.

Wallace (1993) reported "no obvious evidence of large year-class fluctuations" based on length distribution of lake trout in 1991/92. Lake trout age frequency from the current survey indicates similar results with the exception of age 6 fish, which were absent from the netting results (Figure 12). Lake trout age 4 and younger were also absent from the results, however this is most likely due to selectivity of the gill nets, or some aspect of lake trout behaviour. Other lake trout studies within the province have yielded similar results, with few fish younger than 5 years being captured (Dean, 1979a; Dean 1979b; Dean, 1981; Sawchyn, 1987).

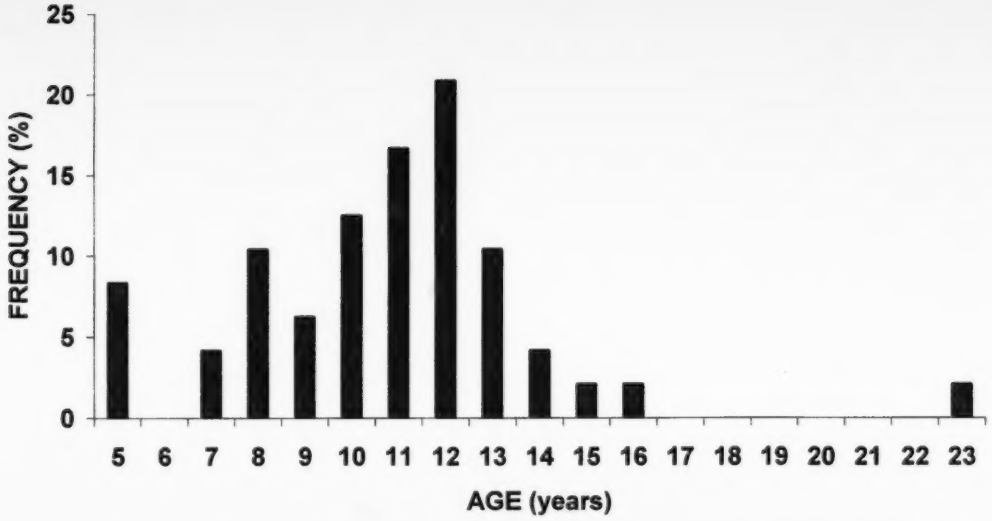

Figure 12. Age frequency for lake trout from Nemeiben Lake, 2003.

Length at age for lake trout from Nemeiben Lake shows slower growth than that seen in other lake trout lakes in Saskatchewan (Figure 13). Higher length at age is seen on heavily exploited lakes such as Lac la Ronge and Hunter Bay, and especially on Whelan Bay of Whiteswan Lake, where the lake trout population was in danger of collapse during the 1970's (Murray, 1979).

Relative weight of lake trout from Nemeiben Lake has decreased significantly since the 1991/92 survey, from 102 to 90 ($t=3.38$, $\alpha=0.05$) (Figure 14). This may be in part due to an increase in lake trout abundance competing for food resources. Stomach content analysis indicated that cisco were a major component of lake trout diet. Ciscos are abundant in Nemeiben Lake, although they have decreased since the previous survey, possibly as a result of increased lake trout abundance. This decrease was particularly seen in nets set deeper than 15m (Appendix 3). There was no significant within year length differences seen.

Figure 13. Length at age comparison for Nemeiben Lake, 2003 and other Shield lake trout populations.

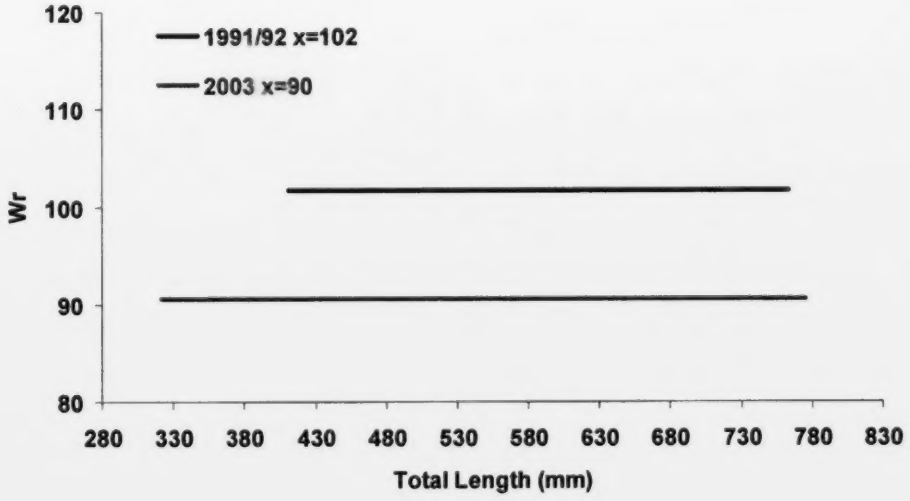

Figure 14. Relative weight of lake trout from Nemeiben Lake, 1991/92 and 2003.

Lake Whitefish

Lake whitefish catches in the current and previous survey have increased from the initial survey in 1960/61 (Table 2; Appendix 2). The current survey caught 155.3% and 307.9% more than the 1991/92 and 1960/61 surveys, respectively. When looking at nets set deeper than 15m, catch of whitefish did not change between the current survey and the previous one (Table 2). A large increase in whitefish catch in water less than 15m lead to a large increase in the weighted average catch for whitefish between surveys (Appendix 3). Whitefish was the only species caught in all 17 net sets.

Fork length frequency for whitefish shows a bi-modal distribution, with peaks at 20-25cm, and 36-41 cm (Figure 15). Mean length at capture was 35.9 cm, with a minimum of 15.1cm and a maximum of 69cm. Wallace (1993) reported a similar range in whitefish sizes, from 20 to 55 cm in 1991/92 while those from the 1960/61 survey were smaller in size.

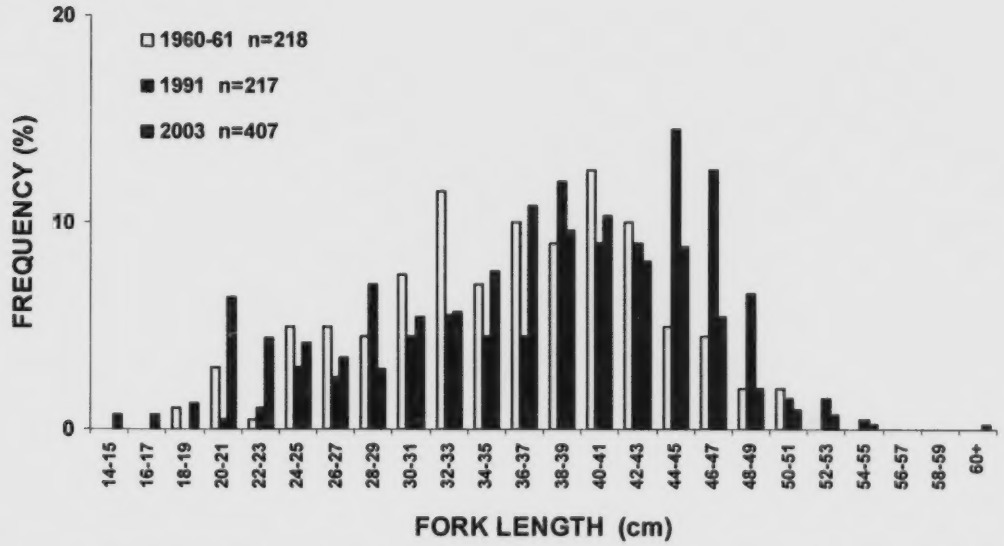

Figure 15. Fork length frequency for whitefish from Nemeiben Lake, 1961/62, 1991/92 and 2003.

Age frequency showed a large range in ages (Figure 16). A peak at age 5 can be seen, with ages ranging from 1 to 30 years. Mean age at capture was 9.9 years. A total of 28 year classes

are represented in the current survey. Few fish in the 3-5 year age range were caught in the previous study (Wallace, 1993), however, these ages accounted for nearly 24% of all fish caught in the current survey.

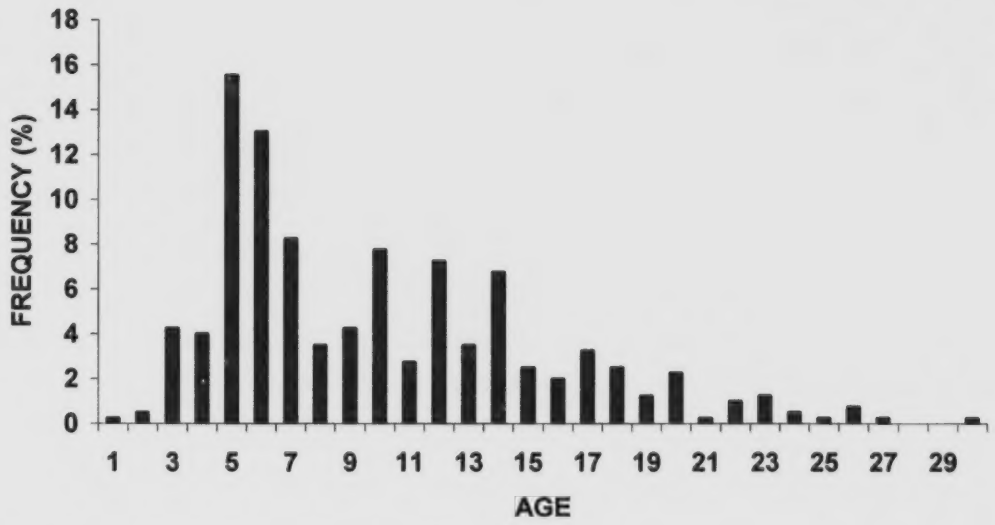

Figure 16. Age frequency for whitefish from Nemeiben Lake, 2003.

Length at age for whitefish from the current survey shows a decrease in growth compared to the 1960/61 survey (Figure 17). The growth rate seen in the current survey is comparable to rates from whitefish in other moderately unexploited populations. Upper Foster Lake (Dean, 1979) has no history of commercial production on it and Jan Lake in 2002 had seen relatively little harvest of whitefish within the last decade (Duffy, in print). Koshinsky (1964) reported that whitefish in Nemeiben Lake prior to his survey were heavily exploited, similar to Jan Lake prior to 1989 (Gloutney, 1990) and Deschambault Lake prior to 1961 (Johnson, 1967). Growth rates for these three populations are fairly similar and all exhibit faster growth than the unexploited populations.

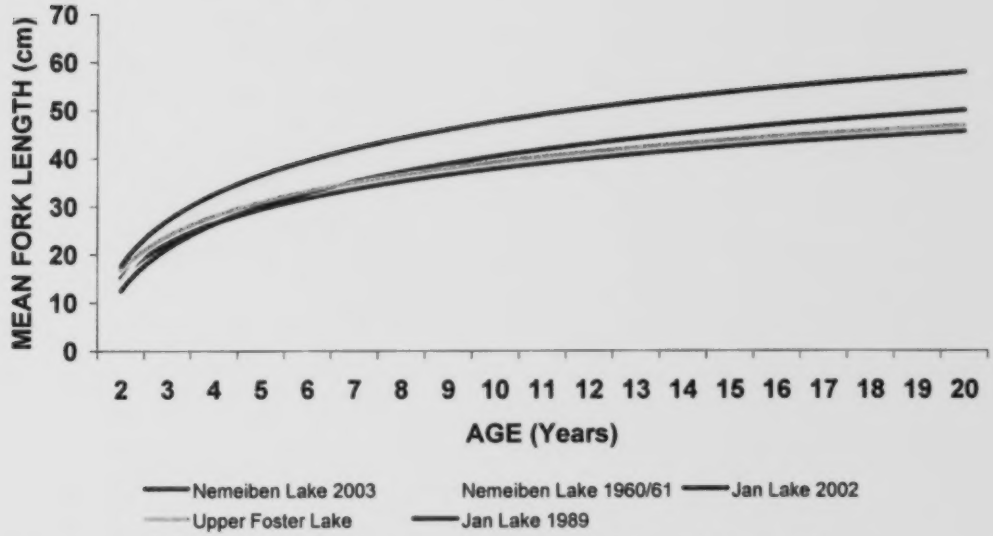

Figure 17. Length at age for whitefish from Nemeiben Lake 1960/61 and 2003, compared to other Shield whitefish populations.

Body condition of whitefish in the current study has not changed since the initial survey in 1960/61 (Figure 18). In comparison to length-weight relationships from other Saskatchewan lakes, Nemeiben Lake whitefish exhibit similar rates of growth. This result is somewhat

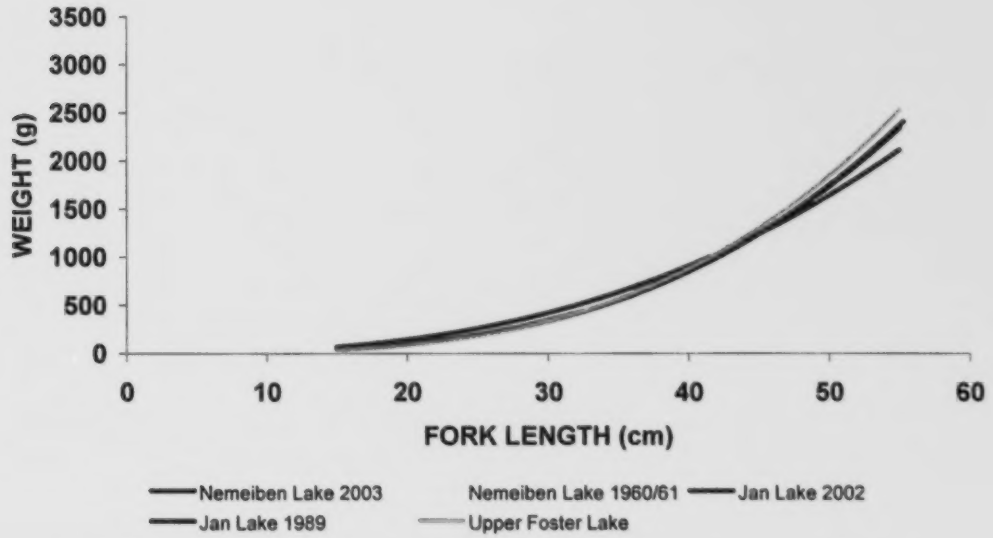

Figure 18. Length-weight relationship for whitefish from Nemeiben Lake, 1960/61 and 2003 compared to other Shield whitefish populations.

unexpected as fish in exploited fisheries tend to have increased weight at length. Relative weight standards for whitefish are not available.

Other Species

All other species of fish captured in the survey nets increased in abundance compared to the previous surveys, with the exception of cisco compared to 1991/92, and burbot in 1960/61 (Appendix 2). The greatest increase was seen in yellow perch, which increased by almost 875% from the prior survey. Cisco abundance decreased to only 71.3% of the numbers seen in 1991/92. Overall, numbers of non-sport and non-commercial species increased by 15.6% and 100.2% from 1991/92 and 1960/61, respectively.

Commercial Harvests

The commercial fishery on Nemeiben Lake has been in place since the 1940's and has been regulated through a variety of quotas (consult Wallace 1993 for a history of quota changes). The quota on Nemeiben Lake was further changed in 2003 from 34,000kg to 20,000kg whitefish; 5,600kg to 3,300kg northern pike; 5,600 kg to 2,500kg walleye and from 600kg 800kg lake trout. The slight increase in lake trout quota was an incentive for fishers to fish the central region of the lake to avoid walleye. Given its proximity to the north bay region, the chances of catching lake trout is higher and the increase was to help keep the fishery open should lake trout harvests increase. There are only three commercial fishermen licensed for Nemeiben Lake through a lake management plan. This plan will help to limit pressure on the lake through limited entry, as well as protecting the eligibility of those fishermen who have historically fished the lake. This number was reduced from four in 2003 by the removal of an inactive fisherman from the eligibility list. The commercial fishing season opens on September 1 of each year to minimize conflict with sport anglers.

Commercial harvests of whitefish prior to the closure of the commercial fishery in 1968 showed cycles of large production, consistently over 15,000kg, followed by a year of harvest less than 5,000kg (Figure 19). Harvest of other species during these periods also showed a depression at the same time as that seen with whitefish indicating that lower production was

most likely due to reduced effort and not due to poor fish stocks. Since commercial fishing started again on Nemeiben Lake in 1977, whitefish harvest has not been at levels seen in previous years. With the exception of 1999/2000 and 2000/01, harvest of whitefish has not exceeded 10,000 kg. Whitefish is currently listed as restricted on Nemeiben Lake due to high *Triaenophorus crassus* infestations and can only be sold to the Freshwater Fisheries Marketing Corporation.

Walleye harvest in the commercial fishery show no regular trends, mostly due to market demands and changes in fish prices. Early in the fishery whitefish were the sought after species, as indicated in their large harvests. Presently, walleye is the most sought after species due to market demands. Headless dressed walleye pay over five times what is paid for whitefish from Nemeiben Lake. Walleye harvests increased in 1994/95 and stayed relatively constant until 1998/99. Since then, there has been a downward trend in harvests (Figure 19). This trend is consistent with the decrease is walleye abundance seen since the last study.

Northern pike has never been a highly desired species in the commercial markets, and as such is more of a by-catch than a sought after species. Its harvest in the commercial catch is most likely a reflection of its abundance in the lake as it shares habitat with walleye.

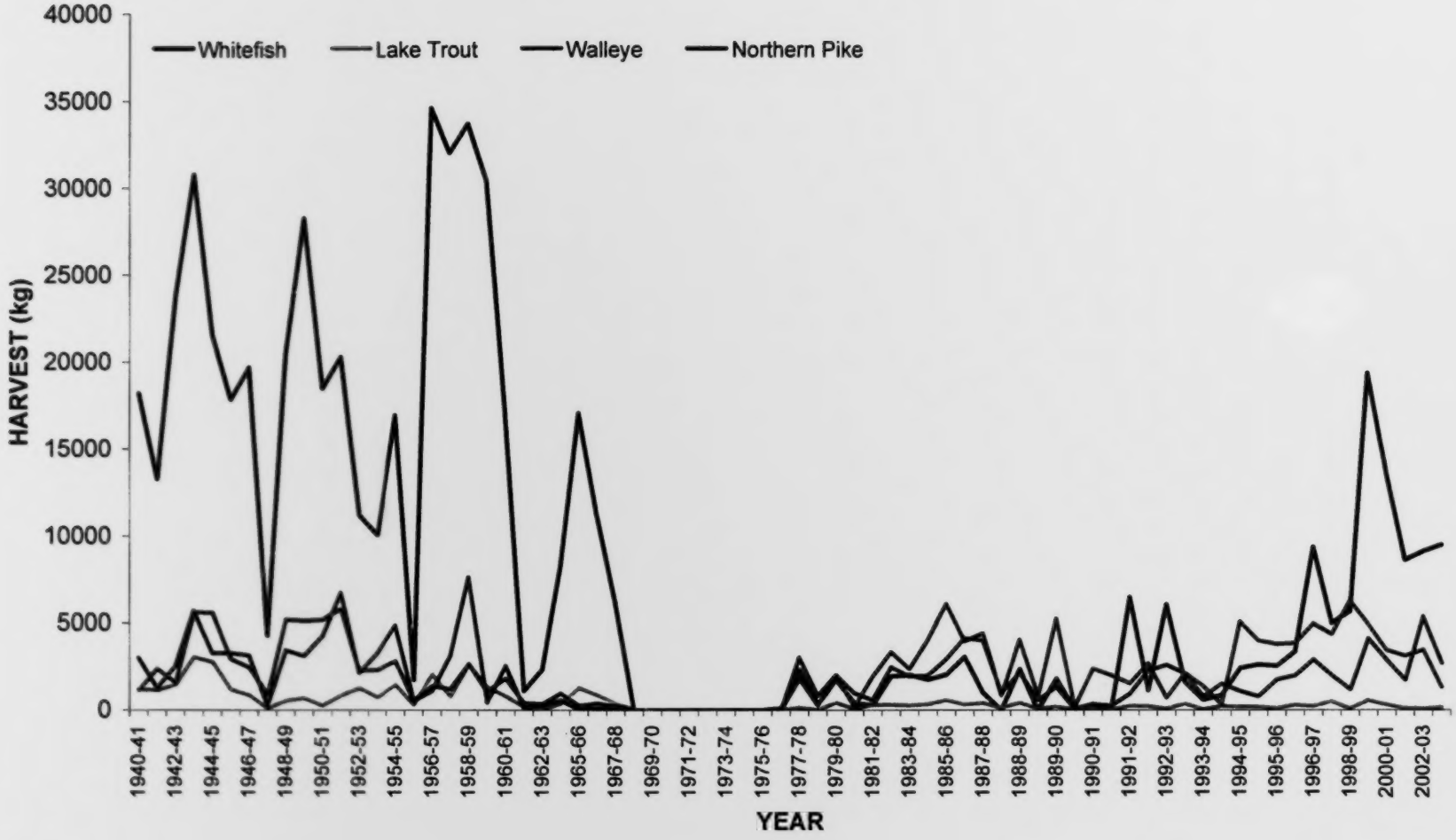

Figure 19. Commercial fishing harvests, Nemeiben Lake 1940-2004.

Similar to northern pike, lake trout is not often targeted due to its current low market value, as well as the low commercial quota on Nemeiben Lake. Harvests have been minimal since fishing started again in 1977. The morphometry of Nemeiben Lake is most likely responsible for low harvests as the trout are confined to the north bay region during the summer months and the majority of the commercial fishing effort is concentrated in the outlet and eastern central regions to target walleye.

Sport Harvest

A creel survey and gut can counts were not performed during the current survey. Data was collected from the one outfitter on Nemeiben Lake during the summer of 1999. Information collected included number of anglers per party, length of fishing trip, amount of time spent fishing, as well as catch and harvest of individual fish species.

Wallace (1993) reported anglers releasing 21% of all walleye caught in 1992, which increased slightly to almost 24% in the 1999 survey. Using the average size of fish from the creel survey in Wallace (1993), and the length-weight regression from the current survey, an estimate of sport harvest from the outfitter is 175 kg. This figure is most likely considerably lower than the actual harvest, which brings into question the validity of outfitter data collection as an alternative to a creel census. Data from the campground and other users is not included in this figure either.

Release rates for northern pike rose from 69% in 1992 to 75% in 1999. Using the method above, harvests by lodge guests in 1999 were 1,335 kg of northern pike.

Lake trout harvest in the earlier surveys was minimal, with most anglers targeting walleye and northern pike (Wallace 1993). The release rate for lake trout in the 1999 outfitter survey at 52% is considerably higher than the usual 10% or lower in trout fisheries (Lester et al, 1991 in Wallace 1993). Harvest estimates are 204 kg using the method above.

Sustainable Yields

Nemeiben Lake is unique in the fact that it has three distinct natural basins to it. As such, sustainable yield for species such as lake trout, which require specific summer habitats, must be calculated based on the area of lake which is suitable for that species. The total surface area of Nemeiben Lake, including Head Lake, is 15,853 hectares, of which 92% (14,584.8 hectares) is less than 15m and 8% is deeper than 15m (1268.2 hectares) (Wallace, 1993).

Walleye and northern pike habitat is that less than 15m, although pike on occasion will be found in deeper waters. "Rule of Thumb" estimates of productivity used by the department allot 0.5 kg/ha/yr for each species when lake trout are present in the lake. Based on the morphometry of Nemeiben Lake, the productivity estimates can be increased to 0.75 kg/ha/yr due to the distinct basins separating lake trout from other species.

With the exception of two net sets in the central region, walleye were only captured in the outlet region of the lake in the current survey. The previous two surveys indicated stronger walleye populations in the central region compared to our results, indicating that walleye utilized both the central and outlet regions and both regions should be included in yield calculations. These regions have a combined surface area of 12,994 hectares. This area is less than the calculated area for depths less than 15m as it does not account for shallow areas in the north bay region, which are marginal habitat for walleye and pike.

The north bay region comprises 2,859 hectares of the total lake area. Lake trout were caught in the central region, however the net set was in the end of May prior to thermal stratification of the lake. Based on area deeper than 15m, optimal lake trout habitat in Nemeiben Lake is 1268.2 hectares, less than half the surface area of north bay region.

Table 3 shows yield estimates for Nemeiben Lake using a variety of productivity estimators. The estimated fish yield was proportioned to the relative abundance by biomass based on the 2003 netting, as well as to the lake area that is optimal to the

particular species, with the exception of the Total Allowable Catch figures. While results are different depending upon the estimator used, walleye yields should be minimized to aid in recovery of the stocks

Table 3. Estimated yields by species for Nemeiben Lake

Productivity Estimator	Walleye	Pike	Trout	Whitefish	Lake Total
Rule of Thumb	9,745	9,745	1,429	15,853	36,772
Depth-Contour	4,904	31,544	1,633	27,327	65,409
Schlesinger-Regier	1,154	7,422	384	6,430	15,390
Rawson	4,230	27,215	1,409	23,577	56,431
Ryder	2,404	15,463	801	13,396	32,063
Hanson-Leggett	2,500	16,081	833	13,932	33,346
Matuszek A	2,308	14,844	768	12,860	30,781
Matuszek B	1,442	9,278	480	8,037	19,238
TAC[a]	28,000	26,000	3,050	22,500	79,550

[a] Chen, 1992

Discussion

Nemeiben Lake has been a popular fishing destination in north central Saskatchewan for many years due to its ease of access and variety of species available for angling. Its popularity has been waning over the past 15 years however, as evidenced in its ranking in the joint Federal-Provincial surveys of sportfishing in Canada. It has fallen from a rank of 15th in 1990 to 19th in 1995 and 24th in 2000. Concern over the walleye stocks in the lake prompted management action to control harvest. This lake study will provide a new background on which the department can gauge the effectiveness of these actions and the need for future management strategies.

Fish Resource

Walleye

Since the initial survey in 1960/61, catches of walleye in survey nets have decreased in each of the two subsequent surveys. In the current survey, both fork length and age frequency indicate a weak bimodal distribution. Although a wide range of age classes were present, the dominance by a single year class is cause for concern. Once these fish are removed from the system, either through natural or fishing mortality, there may be a lack of recruitment to replace them. Growth of walleye has increased since the previous survey in 1960/61 as has body condition, indications of exploitation.

Northern Pike

Northern pike numbers have also decreased from the previous survey, however they have increased considerably since the original survey in 1960/61. Both fork length and age frequency distributions indicate a healthy population. The reason for the large number of age 3 fish is not known, however this year class strength was also evident in other lakes and therefore most likely related to favourable spawning conditions. Length at age for northern pike has increased since the original survey, however is comparable to other heavily utilized lakes in central Saskatchewan.

Lake Trout

Lake trout populations in Nemeiben Lake have shown an increase in numbers since the original survey. Commercial harvest of lake trout was highest prior to the original survey, from 1940-1960. Commercial landings in years since have rarely exceeded 500kg, less than half the average from 1940-1960. A wide range of length and age classes indicates stability in the population, with good signs of recruitment into the fishery. The lack of fish under 5 years of age is not a cause for concern as trout of this age are rarely caught in test nets.

Conclusions and Recommendations

1. Walleye stocks in Nemeiben Lake are showing signs of collapse, despite the reduction in angling harvest limits in 1996 with the elimination of the two-day possession limit. The current reduction to 2 walleye/day for angling and reductions in the commercial fishery should further assist the recovery of the stocks, assuming harvest rates are higher than 2 fish per day. Monitoring of the walleye population in Nemeiben Lake should continue to determine the effectiveness of the reduced harvest levels.

2. Northern pike populations appear to be stable at this time however this may change should anglers start targeting them with the reduced walleye limit. Future monitoring will confirm this.

3. Lake trout populations appear to be relatively unexploited, and may be on the increase. No further management directed towards this species is required at this time. Given the restricted habitat for lake trout in Nemeiben Lake, care should be taken in allocations of this species.

4. No further users of the fish resource are recommended on the lake given the present state of the fish stocks. The current conversion of the outfitting lodge to a cottage subdivision is cause for concern as this may ultimately lead to increased harvests, as the outfitting allocation still exists.

5. Information on fish harvests by user groups other than the commercial fishery should be collected to provide an indication of fish harvests by these groups. Based on results from the 1999 outfitter data collection, this form of data collection is not necessarily reliable.

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Appendix 1. Net set locations and depths from 2003 fieldwork.

Net #	Date Set	Easting	Northing	1.5" Mesh Depth	5.5" Mesh Depth	Region
1	July 14	473027	6138552	113'	132'	North Bay
2	July 15	472059	6129703	41'	56'	Central
3	July 16	469438	6123061	22'	20'	Central
4	July 7	484834	6131268	6'	12'	Outlet
5	July 8	476992	6128947	35'	25'	Outlet
6	May 28	472258	6136245	30'	53'	North Bay
7	May 29	473809	6125468	24'	22'	Central
8	June 9	479650	6129755	23'	16'	Outlet
9	June 10	485547	6129114	6'	6'	Outlet
10	July 22	478836	6141880	84'	100'	North Bay
11	July 23	478759	6140004	65'	77'	North Bay
12	August 18	466413	6122591	19'	24'	Central
13	August 19	484770	6133525	6'	11'	Outlet
14	August 5	469788	6120880	8'	8'	Central
15	June 17	468749	6131716	20'	20'	Central
16	June 19	473515	6134400	20'	26'	Central
17	August 6	467436	6126311	20'	8'	Central

Appendix 2. Number of fish caught in survey nets, 2003, 1991/92, and 1960/61

Month	Net	Region[a]	Depth (m)	Walleye	Pike	Trout	Whitefish	Cisco	Wsucker	LNSucker	Perch	Burbot	Total	Sport & Commercial	Non-sport & non-commercial
2003:															
July	1	N	37.3	0	0	15	87	118	0	0	0	9	229	102	127
July	2	C	14.8	0	12	0	50	88	4	0	8	5	167	62	105
July	3	C	6.4	0	11	0	6	12	54	0	12	0	95	17	78
July	4	O	2.7	13	31	0	4	5	94	0	2	0	149	48	101
July	5	O	9.1	4	14	0	27	57	59	1	15	0	177	45	132
May	6	N	12.6	0	3	10	50	15	0	12	0	2	94	65	29
May	7	C	7.0	0	14	6	27	38	16	0	0	4	105	47	58
June	8	O	5.9	0	35	0	26	38	111	0	20	0	230	61	169
June	9	O	2.0	24	42	0	3	0	91	0	9	0	169	69	100
July	10	N	28.0	0	0	10	51	94	0	0	0	4	159	61	98
July	11	N	21.6	0	9	7	14	16	1	1	0	0	48	30	18
Aug	12	C	6.6	0	6	0	5	0	44	0	50	1	106	11	95
Aug	13	O	2.6	10	9	0	1	0	28	0	15	0	63	20	43
			Total=	51	186	48	351	481	502	14	131	25	1791	638	1153
			Minimum =	0	0	0	1	0	0	0	0	0	48	11	18
			Maximum =	24	42	15	87	118	111	12	50	9	230	102	169
			Mean =	3.92	14.31	3.69	27.00	37.00	38.62	1.08	10.08	1.92	137.77	49.08	88.69
			% of 1991/92[b]	37.2	80.9	165.5	155.3	71.3	173.1	280	873.3	208.3	110.6	102.6	115.6
			% of 1960/61[b,c]	19.5	147.6	2400	307.9	171.2	205.7	466.7	689.5	86.2	165.7	126.6	200.2
Aug	14	C	2.4	4	22	0	4	0	81	0	15	0	126	30	96
June	15	C	6.1	0	29	0	19	14	169	0	3	0	234	48	186
June	16	C	7.0	0	21	0	30	18	35	0	2	0	106	51	55
Aug	17	C	4.3	3	6	0	3	0	17	0	28	0	57	12	45
			Total=	58	264	48	407	513	804	14	179	25	2314	779	1535
			Minimum =	0	0	0	1	0	0	0	0	0	48	11	18
			Maximum =	24	42	15	87	118	169	12	50	9	234	102	186
			Mean =	3.41	15.53	2.82	23.94	30.18	47.29	0.82	10.53	1.47	136.12	45.82	90.29

Month	Net	Region[a]	Depth (m)	Walleye	Pike	Trout	Whitefish	Cisco	Wsucker	LNSucker	Perch	Burbot	Total	Sport & Commercial	Non-sport & non-commercial
1991:															
July	1	N	37.5	0	0	10	48	347	1	0	0	0	406	58	348
July	3	C	7.1	16	18	0	0	6	33	0	5	0	78	34	44
July	4	O	3.1	47	11	0	0	0	72	0	1	0	131	58	73
July	5	O	8.3	10	20	0	34	29	32	0	3	3	131	64	67
1992:															
May	6	N	12.0	6	2	1	26	7	0	3	0	2	47	35	12
May	7	C	7.5	6	33	6	5	11	18	0	0	3	82	50	32
June	8	O	6.0	10	43	0	3	32	40	0	0	0	128	56	72
June	9	O	2.1	14	63	0	8	0	37	0	5	0	127	85	42
July	10	N	29.0	0	0	6	57	145	0	0	0	3	211	63	148
July	11	N	16.8	0	5	6	45	98	2	2	0	1	159	56	103
Aug	12	C	6.9	13	15	0	0	0	34	0	0	0	62	28	34
Aug	13	O	2.3	15	20	0	0	0	21	0	1	0	57	35	22
			Total=	137	230	29	226	675	290	5	15	12	1619	622	997
			Minimum =	0	0	0	0	0	0	0	0	0	47	28	12
			Maximum =	47	63	10	57	347	72	3	5	3	406	85	348
			Mean =	11.42	19.17	2.42	18.83	56.25	24.17	0.42	1.25	1.00	134.92	51.83	83.08
			% of 1960/61	52.2	182.2	1852.8	197.8	239.6	119.0	159.7	77.7	41.1	149.7	123.3	172.8

Month	Net	Region[a]	Depth (m)	Walleye	Pike	Trout	Whitefish	Cisco	Wsucker	LNSucker	Perch	Burbot	Total	Sport & Commercial	Non-sport & non-commercial
1960:															
May	A	N	10	19	1	0	34	3	16	0	0	0	73	54	19
June	B	C	9	2	6	0	2	16	9	0	0	4	39	10	29
June	C	C	5.5	21	18	0	0	26	19	0	2	5	91	39	52
June	D	O	8	7	28	0	0	18	12	0	0	4	69	35	34
June	E	O	2.8	33	14	0	1	1	27	2	1	0	79	48	31
June	F	C	8.5	11	14	0	1	2	11	0	1	0	40	26	14
June	G	C	8	32	13	0	1	5	13	0	3	0	67	46	21
June	H	C	8	9	9	0	0	9	10	0	3	3	43	18	25
June	I	N	27.5	1	4	1	3	124	2	0	0	10	145	9	136
June	J	N	27.5	0	9	0	4	13	1	0	0	1	28	13	15
July	K	C	8	36	25	0	0	39	37	1	1	0	139	61	78
July	L	N	30.5	0	0	0	89	73	0	0	0	6	168	89	79
July	M	N	22.5	0	0	1	15	78	1	2	0	4	101	16	85
August	N	O	4.5	12	9	0	3	0	23	0	1	0	48	24	24
August	O	O	3.5	65	11	0	0	0	45	0	8	0	129	76	53
August	P	N	9	38	11	0	2	0	43	0	2	0	96	51	45
August	Q	O	13	0	0	0	2	2	6	0	1	0	11	2	9
August	R	C	5.5	45	7	0	6	6	43	0	7	1	115	58	57
August	S	C	13	70	3	0	3	12	24	0	1	4	117	76	41
1961:															
June	T	C	5	25	23	0	4	28	58	0	5	0	143	52	91
June	U	N	16	11	8	1	26	13	14	1	1	11	86	46	40
June	V	C	12.5	29	20	0	23	69	39	0	0	3	183	72	111
July	W	O	2.5	37	9	0	0	3	14	0	0	0	63	46	17
			Total=	503	242	3	219	540	467	6	37	56	2073	967	1106
			Minimum=	0	0	0	0	0	0	0	0	0	11	2	9
			Maximum	70	28	1	89	124	58	2	8	11	183	89	136
			Mean=	21.87	10.52	0.13	9.52	23.48	20.30	0.26	1.61	2.43	90.13	42.04	48.09

[a]: N= North Bay, C= Central, O= Outlet

[b]: Only net sets 1-13 used in this analysis

[c]: Numbers from 1960/61 estimated based on % of catch from 1960/61 in Wallace, (1993)

Appendix 3: Average catch per net for shallow and deep water zones, weighted by proportional areas, 1991/92 and 2003

Month	Net	Region[a]	Depth (m)	Walleye	Pike	Trout	Whitefish	Cisco	Wsucker	LNSucker	Perch	Burbot	Total	Sport & Commercial	Non-sport & non-commercial
Nets in water 0-15 m:															
1991:															
July	3	C	7.1	16	18	0	0	6	33	0	5	0	78	34	44
July	4	O	3.1	47	11	0	0	0	72	0	1	0	131	58	73
July	5	O	8.3	10	20	0	34	29	32	0	3	3	131	64	67
1992:															
May	6	N	12.0	6	2	1	26	7	0	3	0	2	47	35	12
May	7	C	7.5	6	33	6	5	11	18	0	0	3	82	50	32
June	8	O	6.0	10	43	0	3	32	40	0	0	0	128	56	72
June	9	O	2.1	14	63	0	8	0	37	0	5	0	127	85	42
Aug	12	C	6.9	13	15	0	0	0	34	0	0	0	62	28	34
Aug	13	O	2.3	15	20	0	0	0	21	0	1	0	57	35	22
			Average (x)=	15.22222	25.00	0.78	8.44	9.44	31.89	0.33	1.67	0.89	93.67	49.44	44.22
			Variance (s^2)=	155.1944	344.50	3.94	161.03	158.53	379.36	1.00	4.50	1.86	1248.00	338.53	488.69
			Proportion of lake 0-15m is 0.92												
Nets in water over 15 m:															
1991															
July	1	N	37.5	0	0	10	48	347	1	0	0	0	406	58	348
1992:															
July	10	N	29.0	0	0	6	57	145	0	0	0	3	211	63	148
July	11	N	16.8	0	5	6	45	98	2	2	0	1	159	56	103
			Average (x)=	0	1.67	7.33	50.00	196.67	1.00	0.67	0.00	1.33	258.67	59.00	199.67
			Variance (s^2)=	0	8.33	5.33	39.00	17502.33	1.00	1.33	0.00	2.33	16956.33	13.00	17008.33
			Proportion of lake >15m is 0.08												
Weighted average, variance, and confidence limits for entire lake															
			Average=	14.00	23.13	1.30	11.77	24.42	29.42	0.36	1.53	0.92	106.87	50.21	56.66
			Variance=	14.60	32.42	0.38	15.23	52.25	35.68	0.10	0.42	0.18	153.54	31.86	82.24
			Standard Error =	3.82	5.69	0.62	3.90	7.23	5.97	0.31	0.65	0.42	12.39	5.64	9.07
			Lower Limit (90%)=	7.08	12.82	0.18	4.70	11.32	18.59	-0.20	0.35	0.16	84.41	39.98	40.23
			Upper Limit (90%)=	20.93	33.45	2.42	18.84	37.52	40.24	0.92	2.71	1.69	129.32	60.44	73.09

Month	Net	Region[a]	Depth (m)	Walleye	Pike	Trout	Whitefish	Cisco	Wsucker	LNSucker	Perch	Burbot	Total	Sport & Commercial	Non-sport & non-commercial
2003[b]															
Nets in water 0-15m:															
July	2	C	14.8	0	12	0	50	88	4	0	8	5	167	62	105
July	3	C	6.4	0	11	0	6	12	54	0	12	0	95	17	78
July	4	O	2.7	13	31	0	4	5	94	0	2	0	149	48	101
July	5	O	9.1	4	14	0	27	57	59	1	15	0	177	45	132
May	6	N	12.6	0	3	10	50	15	0	12	0	2	94	65	29
May	7	C	7.0	0	14	6	27	38	16	0	0	4	105	47	58
June	8	O	5.9	0	35	0	26	38	111	0	20	0	230	61	169
June	9	O	2.0	24	42	0	3	0	91	0	9	0	169	69	100
Aug	12	C	6.6	0	6	0	5	0	44	0	50	1	106	11	95
Aug	13	O	2.6	10	9	0	1	0	28	0	15	0	63	20	43
		Average (x)=		5.10	17.70	1.60	19.90	25.30	50.10	1.30	13.10	1.20	135.50	44.50	91.00
		Variance (s^2)=		66.77	177.79	12.27	362.32	874.90	1525.21	14.23	214.10	3.51	2596.50	455.17	1729.33
		Proportion of lake 0-15m is 0.92													
Nets in water >15m:															
July	1	N	37.3	0	0	15	87	118	0	0	0	9	229	102	127
July	10	N	28.0	0	0	10	51	94	0	0	0	4	159	61	98
July	11	N	21.6	0	9	7	14	16	1	1	0	0	48	30	18
		Average (x)=		0.00	3.00	10.67	50.67	76.00	0.33	0.33	0.00	4.33	145.33	64.33	81.00
		Variance (s2)=		0.00	27.00	16.33	1332.33	2844.00	0.33	0.33	0.00	20.33	8330.33	1304.33	3187.00
		Proportion of lake >15m is 0.08													
Weighted average, variance, and confidence limits for entire lake															
		Average=		4.69	16.52	2.33	22.36	29.36	46.12	1.22	12.05	1.45	136.29	46.09	90.20
		Variance=		6.28	16.78	1.19	36.92	88.35	143.44	1.34	20.13	0.37	261.96	45.59	169.43
		Standard Error =		2.51	4.10	1.09	6.08	9.40	11.98	1.16	4.49	0.61	16.19	6.75	13.02
		Lower Limit (90%)=		0.15	9.10	0.35	11.35	12.32	24.42	-0.87	3.92	0.34	106.96	33.85	66.61
		Upper Limit (90%)=		9.23	23.95	4.30	33.37	46.39	67.82	3.32	20.18	2.56	165.61	58.32	113.79

[a]: N= North Bay, C= Central, O= Outlet

[b]: Only net sets 1-13 used in this analysis